Periodic Reporting for period 1 - Scan4Reco (Multimodal Scanning of Cultural Heritage Assets for their multilayered digitization and preventive conservation via spatiotemporal 4D Reconstruction and 3D Printing)

Reporting period: 2015-10-01 to 2016-09-30

Summary of the context and overall objectives of the project

The European cultural heritage includes a rich variety of cultural items. They consist of various types of materials, the condition of which deteriorates following different time patterns & having different relations with the environmental conditions. Their restoration procedures vary across the whole spectrum of materials & the age of the artifacts makes the problem of their conservation difficult to address.

A crucial step towards the solution of this issue is the effective documentation of the cultural heritage items in terms of not only their current state, but also the estimation of their deterioration & the prevention of any harmful effects, so that all this information becomes accessible to the public & the researchers.

However, a complete documentation of the large numbers of cultural items poses several difficulties. Additionally, the preservation theory deals with the minimization of their deterioration. Thus, preventive conservation is becoming important by allowing a non-destructive preservation of an object.

The current SoA offers promising solutions for both the documentation of cultural objects through diagnostic technologies & the optimal preventive conservation through the simulation of the environmental effects. Finally, information about the object’s materials & stratigraphy can be extracted, other than its shape & appearance, rendering thus a quite rich, multi-modal representation of it.

The latter can be used for study, demonstration & predictive analysis, through the virtual validation of restoration techniques (i.e. hypothesis tests) that otherwise would not be allowed to be applied on the real object.

The main Scan4Reco project’s objectives are listed below:
1. Provide an integrated, portable solution for accurate multi-sensorial 3D scanning & efficient automatic digitization in situ
2. Apply a hierarchical approach for 3D reconstruction of the object to render the object in a multi-layered way
3. Create high precision realistic digital surrogates of the cultural assets
4. Apply material analysis through state-of-the-art laboratory techniques & accurately describe context-dependent ageing models per material
5. Spatiotemporally simulate uni-material models in the future or reaching even back to its original shape
6. Provide suggestions by a Decision Support System
7. Validate the aforementioned actions on real case scenarios
8. Enhance the accessibility with the development of a virtual museum

Work performed from the beginning of the project to the end of the period covered by the report and main results achieved so far
The work performed so far can be summarized into the following points:

1. Analysis of current practices & state of the art (SoA)
   Each partner has performed a detailed state-of-the-art analysis of the scientific areas he is involved in. The range of technologies investigated has been identified based on the user needs & expectations. A technical evaluation of various relevant HW & SW technologies in each technical area was conducted.
   Related Submitted Deliverables:D2.1-Technology Exploration Report;D1.2-Scientific end-user and public requirements
   Related Journal Publication: see Section 6.1
2. Assessment & analysis of user requirements
   The assessment of end-user requirements was carried out through a questionnaire addressed to conservators, curators, conservation scientists, archaeologists & art historians. The questionnaire was proven to be a useful tool to survey the state-of-the-art on acquisition & reconstruction of the surface & sub-surface features of artworks.
   Related Submitted Deliverables:D2.3-Scientific end-user & public requirements
3. Definition of use case scenarios to be used in the validation processes
   Partners decided on the kind of objects to be used in the system’s validation processes defining specifications like size, characteristics of the surface, artistic technique & conservation treatments.
   Related Submitted Deliverables:D2.2-System architecture definition;D3.1-Material related booklet;D3.2-A guide for multi-material palette preparation
4. List of identified technical requirements of the Scan4Reco system
   The technical requirements identification concerned the hardware-related sub-systems of the Scan4Reco system, the control unit that hosts the sub-systems, the definition of operational specifications considering the user engagement into sub-systems & the environmental conditions of the operations’ site (ON LAB, ON SITE, OFF SITE), the definition of the internal/external sub-systems’ communication specifications.
   Related Submitted Deliverables:D2.4-Initial Report on System Specification
5. Definition of the system’s architecture’s first version
   The level of detail of technical, functional & operational descriptions had to be not overly specific, in order to avoid imposing too many implementation constraints at this point of the project for activities requiring research, but also not too general, in order to give a clear direction for all study, research & development activities.
   Related Submitted Deliverables:D2.2-Initial System Architecture
6. Definition of the project’s ethical plan & compliance with institutional ethical requirements
   Scan4Reco follows Cultural-Heritage-related EU legislation, policies, guidelines & will elaborate all available ethical formulations. Italy & Greece, the countries involved in the Scan4Reco use cases, have a rich cultural heritage & became part of European & International agreements for its protection.
   Related Submitted Deliverables:D1.3-Ethical Issues Manual
7. Horizontal activities for the dissemination of the project’s activities
   Partners’ dissemination & communication activities include the SCAN4RECO website, a mailing list of the end-users, a social media strategy, a ZENODO portal, a Wi-Ki portal, 20 publications & 4 project presentations at international events, collaboration with 3 EU funded projects, links to industry outside the project consortium.
   Related Submitted Deliverables:D8.1-Scan4Reco Web Site;D8.2-Communication Plan

Progress beyond the state of the art and expected potential impact (including the socio-economic impact and the wider societal implications of the project so far)

The project’s achievements so far are described in the following:

1. The definition of a challenging but well studied architecture of a smart conservation supportive system that brings together
interdisciplinary technologies, guarantees portability & modularity & facilitates the Human Machine Interaction
2. An advanced process for 3D Tomographic Data Acquisition, based on the combination of UV-VIS, IR spectroscopic mapping imaging, IR imaging, Acoustic Microscopy, IR Raman, xRF sensors
3. A novel pipeline for surface scanning based on microprofilometer & Reflectance Transformation Imaging (RTI) techniques & their combination through image based registration for information comparison & fusion. The innovations in RTI acquisition, semantic feature extraction & reconstruction should be referenced, whereby near-light condition & spatially varying illumination acquisition of geometry & visual appearance of objects was achieved & an improved illuminators modeling was introduced
4. Validation of the applicability of Stevens’ power law for the description of the relationship between transmittance & a perceptually uniform scale for translucency within an optically thin range of materials. This finding will be used for compressing the translucency information in realistic 3D printing

Related information

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